Ontario

Education
Relations
Commission

THE SUDBURY SCHOOL STRIKE AND LAURENTIAN STUDENTS

ISBN 0-7743-8942-7

THE SUDBURY SCHOOL STRIKE AND LAURENTIAN STUDENTS

Derek Wilkinson
Department of Sociology
Laurentian University
Sudbury
Ontario P3E 2C6

Not for citation or quotation without the author's permission.

FORWARD

Prior to and since the enactment of the **School Boards and Teachers Collective Negotiations Act** in July of 1975, there has been considerable discussion with regard to the use of sanctions (strikes and lockouts) by teacher federations and school boards in the Province of Ontario.

The Act does enable sanctions to occur following a series of required steps intended to resolve negotiation impasses. The Act also establishes the Education Relations Commission to administer and supervise the teacher/school board bargaining process. While the Commission undertakes a variety of functions to facilitate negotiations -- such as the constant monitoring of their progress, appointing third parties to assist the parties and providing a wealth of data -- sanctions have occurred. Over the eight-year period since the legislation's proclamation thirty-three (33) sanctions have taken place.

This total is a small proportion -- 2.3% -- of all negotiations. Nevertheless, those interested, whether directly or in terms of a consideration of an important public policy issue, will continue to reflect upon this matter.

The legislature, when statutorily confirming the right of the parties to engage in sanction activities, recognized that such activities could not be without limit because of their potentially disruptive impact on the normal school program. Specifically, one of the duties assigned to the Commission in the legislation is:

> ...to advise the Lieutenant Governor in Council when, in the opinion of the Commission, the continuance of a strike, lock-out or closing of a school or schools will place in jeopardy the successful completion of courses of study by the students affected by the strike, lock-out or closing of the school or schools.

Therefore, the Commission has endeavoured since its inception to gauge the possible impact of sanctions upon students. These efforts have taken a variety of means during and after a sanction such as analyses

of enrolement patterns, surveys of parents and students and gathering other, more impressionistic, data.

Following the conclusion of the teacher strike and school board lockout within the Sudbury Board of Education's secondary panel during the 1979-80 school year (which was the longest interruption of teaching services experienced to date under the Act), the Commission contracted with Dr. Derek Wilkinson to undertake an empirical investigation of the impact upon those Sudbury students who, in the year after the sanction, entered Laurentian University.

To isolate and identify the effect of any influence upon student development is a most challenging task. While this Commission-sponsored endeavour will not satisfy those who seek absolute answers, it is a carefully designed piece of research. Perhaps more importantly, it is a detailed attempt to further the process of objectively considering this important dimension of public policy.

This document presents the results of Dr. Wilkinson's study. As with reports of this nature, the views expressed and conclusions reached are those of the author and not necessarily those of the Education Relations Commission.

Bryan M. Downie
Chairman
Education Relations Commission

Preface

Parents and the public have often been concerned about the effect teachers' strikes might have on students. It has been an imagined effect because the appropriate research has not been done. Existing studies have looked at either the perceptions of the participants or year-end grades. This study presents some data on the objective effects on Grade Thirteen students of a specific strike as measured by the grades and failures of these students in their next year at university.

The initial intention of the current study was to look at both Laurentian University students and Cambrian College Students. However delays in obtaining all the material from Cambrian were so substantial that it was decided to complete the report on the basis of data from Laurentian students. The analysis of Cambrian students would have involved the effects of Grade 12 rather than Grade 13, and hence in any event would constitute a somewhat separate topic.

A number of people contributed to this project. I should like to thank Doug Fleming and Ray Shirley from Computer Services at Laurentian. Mike Herman initially suggested the idea of studying the strike. Jack Porter, the Registrar, gave me permission and access to student data. Ron Smith, Associate Registrar, explained aspects of the university registration system, and both he and Mirko Mehes, Assistant Registrar, commented on an earlier draft. George Thompson, Director of Education for the Sudbury Board of

Education, took the time to make written corrections on a later version.

The Education Relations Commission agreed to provide funding for the research. I should like to thank both Rodger Allan, the former Chief Executive Officer, and Bob Field, the current Chief Executive Officer, for their support. Ed Aim, and other members of the E.R.C. research staff made helpful comments on everything I submitted to them. The detailed and incisive comments of their anonymous external evaluator were invaluable.

Professor Henry Radecki encouraged me, provided me with a good example in the professional way in which he carried out his research project on the strike, and made suggestions. Professor Ken Menzies read and commented on an earlier version. Professors Abraham Barnett, Michael Persinger, and Keith Sinclair discussed aspects of the methodology with me. Professors Stewart Crysdale, Neil MacKinnon, and Tony Turrittin consented to read the study, and I am grateful for their helpful comments.

Also I should like to thank Anne-Marie Caveen and especially Diane Beatty who helped with coding, typing and manuscript preparation.

Having had so much help, I cannot take much credit for whatever virtues this study may manifest, but I nevertheless can accept total blame for its defects.

Table of Contents

Chapter 1: Introduction

Sudbury
The School Board and Schools Affected
The Strike
Laurentian University
Aims of the Study
The Organization of the Report

Chapter 2: Review of the Literature

Introduction
Holmes' Study
Fullan and Eastabrook
Watson and Gill
Brison
Caldwell and Moskalski
More General Research
Summary

Chapter 3: Preliminary Statistical Analysis

Introduction
Sample and Rejection Rates

General Characteristics of the Sample
Description of Independent Variables
Description of Dependent Variables
Marks
Failures
Withdrawals
Extent of Data for Strike Students
Number and Grades of Strike Students
with Missing High School Data
The Effects of Time
The Effects of School Board
Summary

Chapter 4: Statistical Analysis of Marks

Introduction
The Effect of the Strike on Grades
The Necessity for Multivariate Analysis
Correlations Underlying Regression
The Methods of Analysis
Problems with using Regression
Stepwise Regression after Controlling for Grade Thirteen
Comparing Multiple Correlations
between Regression Equations
Comparing Betas in Regression Equations
Summary

Chapter 5: Statistical Analysis of Failures

Introduction

Failure Rates of Strike and Non-strike Students

Multivariate Analysis

Correlations Underlying Regressions

Comparing Multiple Correlations
between Regression Equations

Comparing Betas in Regression Equations

Summary

Chapter 6: Statistical Analysis of Withdrawals

Introduction

Withdrawal Rates of Strike and Nonstrike Students

Correlations Underlying Regressions

Comparing Multiple Correlations
between Regression Equations

Summary

Chapter 7: Some Problems of Interpretation

Introduction

An Alternative Account

Selection Characteristics

University Choice by Area of Origin

The Consequent Irrelevance of Socioeconomic Status

The Effects of Substitute Education

Assuming the Validity of University Grades

Summary

Chapter 8: Conclusion

Recapitulating the Findings

The Effect of Grade Thirteen

Explaining the Lack of Effect

Concluding Results

References

Index of Tables

3.1 Rejection Rates for Student Records by Year

3.2 Sex and Year of Students

3.3 Year and Language of Students

3.4 Year and School Board of Students

3.5 Means and Standard Deviations for Independent Variables

3.6 Correlations Between Independent Variables

3.7 Letter Codes for Courses

3.8 Courses Classified in Different Faculties

3.9 Marks for Subject Areas

3.10 Overall and Faculty Marks

3.11 Percentage Failing Specific Subjects

3.12 Overall and Faculty Percentages of Students Having Failed

3.13 Percent Withdrawing from Specific Subjects

3.14 Overall and Faculty Percentages of Students Withdrawing

3.15 Average Grades for Strike Students

3.16 Faculty Grades by Data on High School Marks for Strike Students Only

3.17 Overall and Faculty Marks by Year

3.18 Faculty Percentages of Students Failing by Year

3.19 Faculty Percentages of Students Withdrawing by Year

3.20 Overall and Faculty Marks by School Board

3.21 Faculty Percentages of Students Failing by School Board

3.22 Faculty Percentages of Students Withdrawing by School Board

4.1 Subject Marks of Strike Students and Others

4.2 Faculty Grades for Strike and Non-strike Students

4.3 Correlations Between Independent and Dependent Variables

4.4 Parameters of the Regression of Grade 13 on Faculty Grades

4.5 Regression of Deviations from Predicted Grades with Other Included Variables and Strike

4.6 R-Squared Change from Adding Strike to a Two-Variable Model Predicting Marks

4.7 R-Squared Change from Adding Strike to a Three-Variable Model Predicting Marks

4.8 Standardized Regression Coefficients or Betas for more complete models

5.1 Failure Rates by Subject Area and Strike

5.2 Failure Rates by Faculty

5.3 Correlations Between Independent Variables and Failure Rates

5.4 R-Squared Change from Adding Strike to a Two-Variable Model Predicting Failures

5.5 R-Squared Change from Adding Strike to a Three-Variable Model Predicting Failures

5.6 Betas for Predicting Failure from Several Independent Variables

6.1 Withdrawal Rates by Subject Area and Strike

6.2 Withdrawal Rates by Faculty

6.3 Correlations Between Independent Variables and Withdrawal Rates

6.4 R-Squared Change from Adding Strike to a Two-Variable Model Predicting Withdrawals

7.1 Percent Registered of all Area 12 Students

7.2 Percent of Registered Students from Area 12 Choosing Science or Arts

Chapter One

Introduction

In 1980, the secondary school teachers of Sudbury went on strike. The strike led to 56 lost school days for about 13,000 students. It began on February 6, 1980, and continued until May 7, 1980. This study involves a description of some of the effects of this strike on students who continued to university.

Many students from Sudbury schools attend Laurentian University. This study used those students as an index of the effects of the school strike. We inquired specifically into the effects of the school strike on first-year grades. In the attempt to derive an indicator of this effect, all students entering Laurentian the year after the strike were considered. Then students who were from Sudbury schools, affected by the strike, were compared with students from other schools, who had not been so affected. The resultant grade differentials will be a product of the influence of the strike mixed in with the influence of other factors. However, there are always a number of alternative possible interpretations when social scientists fail to use strictly randomized assignments of subjects to different experimental treatments. This is even more the case here because this was a natural experiment where there were elements of selection involved. To minimize these risks and to have a comparison of the general performance of Sudbury and other students, we

also collected data on the first-year performance of students entering Laurentian in the four years preceding the entrance year of those affected by the strike.

Sudbury

Sudbury, with about 150,000 inhabitants, is the largest city in Northern Ontario. It is 230 miles north of Toronto. For a long time, it was a single industry mining town, differing from others in this category in having two large companies, INCO and Falconbridge, rather than one. Thus it is somewhat different from the communities studied by Lucas(1971). Inco has been studied by Thompson and Beasley(1960), Swift et. al. (1977), and Clement(1981). Falconbridge has been studied by Deverell et al. (1975). The 1978 Inco workers' strike is the subject of two reports by Radecki (1979;1981). Higgins and Peake (1973) provide a summary history of the city.

That community characteristics influenced the course of the teachers' strike is shown by Radecki and Evans (1982). However there do not appear to be any reasons why the effect of the strike on students should be different in Sudbury from what it would have been elsewhere. Perhaps some other communities would have had more alternative sources of support for student self-education during the strike, but it is unlikely that this played a major role.

Chapter One
Introduction

The School Board and Schools Affected

The Sudbury Board of Education was responsible at the time of the strike for seventeen secondary schools. Capreol High School, Copper Cliff High School, and Sudbury Secondary School predated WWII. The Post-WWII schools are Chelmsford, Confederation, Franco-Jeunesse, French River, Garson-Falconbridge, Hanmer, Lasalle, Levack, Lively, Lockerby, Lo-Ellen, MacDonald-Cartier, Nickel District, and Rayside. Copper Cliff High School was closed in September 1980 just after the strike. These schools came under regional control when, with the 1969 consolidation of school boards in the province of Ontario, a Regional School Board was set up.

The Strike

The teachers' strike came in the wake of an INCO strike of long duration. As a result of this strike and an earlier one in 1958, there was some sympathy in the community for strikers. This may have influenced the teachers' willingness to continue the strike.

The educational background of Sudbury was similar to that of other school districts in Ontario. In this period of declining enrolment and rising costs, school boards were being pressured by the Ontario government as well as local ratepayers to reduce educational expenditures. Evidence of this is the debate at the time over school closures. Increasing inflation led to teacher demands for pay increases. Declining enrolments and school closures caused

teachers to worry about job security. This worry was augmented by an increase in the proportion of French immersion students since this meant fewer jobs for existing English-speaking teachers who could not be transferred to the French program.

After this relatively bitter strike, the longest in Ontario's educational history, teachers refused to participate in an extension of the school year or a summer make-up program for students affected by the strike. If strikes do have effectss then this strike, by virtue of both its length and the absence of a following compensatory program, should have important and measurable effects.

A detailed analysis of the sequence of events during the strike and a catalogue of the views of the participants have been presented in some detail by Radecki and Evans (1982).Their analysis also looks at the effects of the strike on parents, teachers, and the community. A wide range of interviews and a discussion of post-strike events provided their main source of information.

Laurentian University

Laurentian University was founded in 1960 and currently has an enrollment of 2000 students. It has a bilingual program, primarily in Arts and Social Science, but less than 20% of students take their courses in French. Laurentian is primarily an undergraduate institution with only a small number of graduate programs.

The university is divided administratively into four

Faculties: Natural Science, Social Science, Arts and Professional Schools. Historically there has been a shift in enrolment from Natural Science to Social Science and more recently to Professional Schools. Table 3.8 shows the courses allocated to each Faculty while Table 3.7 gives the expanded names for the course mnemonics used.

Since Sudbury is relatively isolated from other universities, with the nearest similarly-sized institution being over two hundred miles away, a relatively large percentage of Sudbury-district students who do go on to university enroll at Laurentian. An administrative area larger than Sudbury district but including it sends between a quarter and a third of its university-going students to Laurentian, as will be shown in Table 7.1. The proportion of students from Sudbury who attend Laurentian is likely to be higher. Thus there existed a large sample of accessible students who had been in Grade 13 at the time of the strike. To follow a similarly sized sample from a Southern Ontario school board would have been substantially more costly and, even then, grades from different universities would have been less comparable. Students entering Laurentian from other areas provided a natural control group.

Aims of the Study

The study developed here was intended to be complementary to the Radecki-Evans study, focusing on a much narrower issue - the objective effects of the strike on students. Some other studies have looked at school grades

after strikes and these will be reviewed in Chapter Two, but no one had looked at the effect of strikes on grades in further education. This was a gap in the literature which the current study attempts to fill.

Clearly one ought not to trust grades which have been assigned by teachers who have been involved in a strike that year for, apart from the general variability among schools, teachers may compensate in their marking for a shorter curriculum. The current study avoids both problems.

Subject to a number of assumptions explained and defended in Chapter Seven, the study shows the objective effects on university students of having experienced the strike. Although only first year grades are considered, it is unlikely that effects which do not show up in the year immediately following the strike will greatly affect performance thereafter.

Although there are many other effects which strikes could have had on these students, it is likely that the most important factor was the absence of schooling for the period. Heyns (1980) has shown that black disadvantaged children do not increase their performance levels when not attending school during the summer holidays and consequently considers attendance at elementary school quite important. We expected our students to suffer similarly from absence during the strike. On the other hand, a lack of effect from the strike might mean that the equivalent amount of teaching in Grade 13 had no effect. From this perspective, the study appears as a test of the utility of three months of Grade 13 instruction.

In that sense it may have some utility as evidence bearing on the question of the abolition of Grade 13.

But it is unlikely that Grade 13 is less important in education than other grades. Certainly students generally put more work into school in their final year. Therefore this study can be interpreted as a partial test of the effects of three months of education.

Given the size of the sample, it is unlikely that a negative result would arise from totally random causes. A negative result could be attributed to specific features of the particular education system in question. It could also be attributed to the crudity of university grades as a measure. Some other possibilities are considered in Chapter Seven.

It would be wrong however to conclude that, if three months does not affect education, one or two years would not either. There must be some level at which there would be recognizable effects. However it is reasonable to conclude that the longer the period without effects, the more flexible is the given educational system at that level and the less critical are interruptions.

The Organization of the Report

The organization of the report is as follows. Chapter Two presents a review of what literature there is on the direct effects of teacher strikes on student achievement. Chapter Three gives an overview of the sample and shows breakdowns by sex, year, etc. It gives the definitions,

means and standard deviations of all the variables used in the study. Chapter Four compares the marks achieved by strike students with those achieved by other students. Following this, marks are analyzed in a multiple regression to check the effects of the strike. Chapter Five analyzes failures, first with percentage failing of strike and nonstrike students, and then in a multivariate analysis. Chapter Six presents a similar analysis of withdrawals. Chapter Seven returns to some of the concerns expressed here in order to argue against alternative explanations of the data. Chapter Eight contains the conclusion.

Chapter Two

Review of the Literature

Introduction

There is little material available on the effects of teachers' strikes. A keyword search of ERIC files using the terms (Teacher), (Strike) and (Student Marks or Student Achievement) produced only four citations.

Two of these were produced by the Ontario Ministry of Education. The first citation entitled "Three Studies of the Effects of Teachers' Strikes" was edited by David Brison. The titles are "The Effects of Ontario Teachers' Strikes on Students - Student Achievement" (Mark Holmes, 1979), "The Effects of Ontario Teachers'Strikes on the Attitudes and Perceptions of Grades 12 and 13 Students" (Michael Fullan and Glenn Eastabrook, 1979), and "The Effects of Ontario Teachers' Strikes on Students: Effects on Student Flow, Dropout and Transitions" (Cicely Watson and Mohindra Gill, 1979) The second citation, entitled "The Effects of Ontario Teachers' Strikes on Students" is a summary and account by Brison.

This literature deserves close attention since it is basically the only source and it deals with Ontario. Therefore we shall summarize here the relevant aspects of each study.

Holmes' Study

Holmes aims to answer the question: "What effects do

strikes by Ontario teachers have on the achievement of students?". He argues that marks may be clearly related to achievement. He states:

> School marks reflect the standards of teachers and we have no way of knowing to what extent the standards fluctuate according to the circumstances. (Holmes, 1979:3)

Holmes looks at arguments relating time in school to achievement. He emphasized the possible indirect effects of schooling, and particular, those which affect all children in and out of school.

Holmes' third hypothesis based on this argument is most relevant. He states:

> A reduction in the instructional time will not have a measurable effect on general outcomes of education that are achieved over a long period of time, particularly where some combination of the following factors is present: the objectives are achieved outside as well as inside the school; the objectives are measured in very general ways; instruction towards the objectives is indirect; individual differences in intelligence and cultural background have much greater effect on achievement than differences in instruction. (Holmes, 1979:17-18)

Holmes emphasizes the difficulties in controlling for other variables. He states in this regard:

> ...if we are to address seriously the problem of student achievement, base-line data are necessary and they must

be collected in the context of research that reasonably takes into account the variables which we believe affect student performance. (Holmes, 1979:28)

Specifically with respect to Grade 13, Holmes states:

The overall effect of the entire loss of grade 13 would probably be minimal. (Holmes, 1979:30)

Holmes then considers marks, which share only 25% of the variance with results on objective tests. He adduces eight types of factors explaining variation in teachers' marks.

After elaborating on some reasons for not trusting teacher-assigned marks, Holmes turns to the empirical results. He states:

Overall, there was no discernible changes in any subject, in any school in any board. (Holmes, 1979:43)

Holmes discounts drop-outs as a factor in maintaining the mark level. Also he found that the number of Ontario scholarships did not decrease.

The only effect was a decrease in the number of students obtaining honour graduation diplomas. This however could be due Holmes says to a large number of alternative factors. Holmes' summary makes this evident. He states:

It does seem that there were fewer (but not significantly fewer) Grade 13 graduates in strike years - particularly in Metropolitan Toronto in 1976. A change is slightly more evident for girls than for boys. The evidence suggests that this change is unlikely to be attributable simply to teacher behavior in school - to low marks, more failures, lower achievement. The

> reduction may not even be related to the strike - it may reflect a disenchantment with education given the current economic situation or it may reflect other factors completely unrelated to the strike. A further possibility is that the strike may have further disheartened the already disenchanted. It did not apparently affect the overall distribution of marks by teachers and did not affect either marks or graduation diplomas except at the Grade 13 level. (Holmes, 1979:67)

Holmes concludes his discussion by stating:

> In sum, there is no reason to believe that teachers' strikes in Ontario have had major shortterm, still less longterm, effects on students' achievement or life chances.(1979:68)

Fullan and Eastabrook

Fullan and Eastabrook focused primarily on attitudes and perceptions. However one of their findings does relate to achievement. They say:

> ...a large majority of students in the survey sample (74%) and in the interview sample said that parts of course curriculum were removed or eliminated when they returned from the strike. There were two different perceptions of the consequences of this removal. One group of students stated that the removal was not harmful, because it consisted of non-core material, or the material was irrelevant to their current

post-secondary program. Another group felt that the removal of material was harmful to them. Because they had missed or rushed over material they felt that their marks or knowledge base had suffered. (Fullan and Eastabrook, 1979:159)

They also found:

...on the direct question of whether the strike had "affected ability or motivation to obtain an education beyond the secondary school level", 21% of the survey sample and 33% of the interview sample said yes. Students who claimed a negative impact referred to one or more of the following: (i) lower grades, (ii) loss of study habits, and an increase in laziness, (iii) lower desire to obtain further education, or (iv) loss of respect for teachers. Those who indicated no impact stated that they were independent and motivated enough that a strike would not affect them. About 3% of the survey sample said that the strike experience increased their motivation by making them more self reliant. Students from both groups (those affected and those not affected by the strike) reported that many students dropped out of school as a result of the strike. However, we have no direct data on these students. (Fullan and Eastabrook, 1979:160)

Differential suggestions of Fullan and Eastabrook were that students subsequently in degree programs did more school-related work during the strike. Girls did more school work during and after the strike and were less affected.

Also students with parents from higher occupational brackets experienced less impact. In addition they found students in post secondary courses requiring basic skills like math/sciences or technology programs were more likely to feel affected by the strike.

Unlike Holmes, then, Fullan and Eastabrook envisage the strike as having had marked negative effects.

Watson and Gill

Watson and Gill focused primarily on the droupout effect. They found that dropout rates increased in strike-affected boards.

Watson and Gill in their third chapter look at grades 12 and 13. They found that:

> In the strike year withdrawal (within the year dropout) rates significantly increased in all grades of the schools of the systems on strike. The highest increases were observed for Grades 12 and 13. The statistics suggest that this development was not part of a general provincial trend; it was not shared by the rest of the province. (Watson and Gill, 1979:175)

This shows that the strikes in 1975/76 led to fewer students applying for university. This is a point which must be kept in mind when considering the effects of the Sudbury strike. It will be considered in Chapter Six.

With respect to university registration, Watson and Gill found:

> For the strike sample and for four of the individual

boards the ratio of the number of university applicants to Grade 13 enrollment decreased significantly in the strike year and decreased again in the post-strike year. For the non-strike boards (as a whole) there was no change in the ratio in the strike year. There was a significant reduction in the year following the strike but it was of lesser magnitude than that of the strike group. The ratios were .76, .72, .68 for the latter vs. .73, .73 and .71 the former (sic).

...For the strike sample and for seven of the ten boards there was a decline in the ratio of university registrants to university applicants from 1974/75 to the strike year, 1975/76. The decline was statistically significant for the sample as a whole and for two systems; for another system there was a statistically significant increase in the ratio that year. For the rest of Ontario the ratio increased significantly in the strike year but decreased significantly the next. For the strike sample, after the significant decrease of the strike year the ratio remained unchanged. The ratios were .72, .69, .69 (strike boards) vs. .73, .74, .72 (non-strike boards). (Watson and Gill, 1979:184)

They summarize their arguments on this issue by stating that:

...the Grade 13 to university transition was adversely affected to a significant degree in the strike boards. (Watson and Gill, 1979:185)

Siding more with Fullan and Eastabrook than Holmes,

Watson and Gill conclude: ...that the average marks of students of strike boards applying for science programs, those in engineering, commerce and business, and in nursing were unduly depressed in the year of the strike and that these students, as a result of the strike, were placed in a disadvantageous position. (1979:188)

Brison

Brison argues, in summarizing Holmes, that it is "unacceptable methodologically" to rely on teachers' marks to measure student performance. He states:

> In a strike situation there is always the possibility that effects on student marks happen wholly or partially as a result of strike-related changes in the way in which teachers assign marks, and not directly because of changes in the achievement of the students themselves. (Brison, 1978:18)

And further:

> ...without some direct information on how a strike changes teachers' marking behavior, any inferences from student marks to objective levels of achievement are suspect. (Brison, 1978:18)

He states that the study found:

> ...no consistent strike impact on marks in the strike year in comparison with the preceding year, nor any consistent impact by subject. (Brison, 1978:22)

He then reiterates his caveat about the use of marks:

> Marks, which are teacher-assigned, may not be a good way

> of assessing "objective" achievement around a strike, and about "objective" achievement we can make no sound inferences from the data available to us from this component study. (Brison, 1978:22)

In Chapter 3, Brison attempts to develop a theoretical framework for understanding the effects of strikes. However, the theory is framed at such a general level as to make a summary inappropriate here, in spite of its plausibility. It will suffice to report the theoretical hypotheses specifically relating to secondary school strikes. These are:

> Strike effects are more likely to be observed at senior grade levels. (Brison, 1978:66)

> At senior grade level strike effects are more likely in "hard" subject areas than in "soft." (Brison, 1978:67)

> Strike effects at senior secondary grade levels will not be patterned by parents' socioeconomic status and will not show minority-home-language effects. (Brison, 1978:67)

and

> Strike effects are likely to be least pronounced at senior secondary grades for (i) those students who grasp general understandings without practice; (ii) those students sufficiently self-disciplined to compensate on their own for losses in in-school practice time. (Brison, 1978:68)

In the summary supporting this proposition about "hard" subjects, Brison again argues against marks. He then states:

> If our interpretation of these findings is correct, this discovery of a differentiated impact by subject area is an important one. It is perhaps the most important insight into the potential impact of strikes that this research project has to offer. (Brison, 1978:77)

Caldwell and Moskalski

An American study reported by Caldwell and Moskalski looked at school districts in Pennsylvania. They used the Educational Quality Assessment (EQA) to measure the effect of strikes on reading and mathematics scores. They compared the mean scores at the beginning and end of a period for school districts which experienced strikes with those for school districts which had continued to be strike-free. Data elements in the sample were mean scores for school buildings for grades 5, 8, and 11.

Results of their analysis were that school districts having 19 to 24 day strikes had significantly lowered reading scores at all grade levels. Those having strikes over 13 days had significantly lower math scores.

This would suggest that the strikes did have some negative impact on objective ability. However a number of likely correlates of strike activity were uncontrolled and these could have confounded the results.

Caldwell and Moskalski's results do appear to show a stronger effect on those in earlier grades. This contradicts

the aforementioned hypothesis of Brison that effects will be greater the more senior the level of the student.

More General Research

Much teaching effectiveness research can be seen as school relevance research but is based on specific interventions and specially designed tests whether of specific lessons or more objective tests of general achievement rather than on practical results in real-life situations. In any event, it would be impossible to summarize all the work in this area. Instead a few noted and relevant works will be cited to show that there is not agreement on expectations and findings of the effects of school. The aim of this section, then, is not to summarize what has been done, but merely to show that there are some more general and abstract approaches which disagree in what they would predict about the effects of strikes or of missing school.

Jean Piaget, in The Science of Education (1970), condemns Departments of Education for failing to test what kinds of effects schools have in the long term. He states that these tests are not carried out because of a probable lack of effect. His theory, however, implies that the effects of education are the result of the induced activity of the child over a long period and in many situations so it is likely that he would not expect demonstrable effects over a short period.

Herbert Hyman published an analysis in 1975 aptly

entitled The Enduring Effects of Education. It was based on American studies. He shows that education has a demonstrable effect on the knowledge and values of adults. However like Piaget he sees these effects as based on cumulative schooling and would not see them as resulting from relatively short periods.

Barbara Heyns did an important American study looking at the effects of summer schooling (1979). She reasoned that it would be possible to look at the effects of schooling by comparing students who attended some school during the summer holidays with students who did not. On the whole her results were positive indicating that those students not attending did not advance at the same rate as those attending. Her study is the most important source arguing for an important effect for even short-term schooling. However the fact that she is dealing primarily with disadvantaged children may have been important in the production of her results.

The argument relating to general research on what effects education has is that there is not agreement. Although much research may be taking place in this area, none has achieved any claim to universally accepted paradigmatic status. The cursory selection of Heyns, Hyman, and Piaget shows that dissensus is possible.

Summary

Existing research is inconsistent in its implications. Holmes suggests that reducing time in school would not make any measurable difference, and that eliminating all of Grade

13 would not have much effect. Fullan and Eastabrook think post-secondary students in mathematics and science programs would suffer. Brison claims the most important insight of his research project was "a differentiated impact by subject area". Obviously if there is no impact, the impact cannot be differentiated. The scarcity of existing research leaves us in a quite ambiguous position about the objective effects of strikes on post-secondary education.

Some theories about the effects of education would tend to minimize the effects for short periods of schooling. One specific study by Heyns seems on the contrary to point to its importance. Again the results are inconsistent. This really is an area where the results of research are not all in.

Chapter Three

Preliminary Statistical Analysis

Introduction

This chapter describes the source of the sample and some of its general characteristics. It then gives definitions, means, and standard deviations for all the variables used. Independent variables are presented first, and then the three sets of dependent variables, marks, failures, and withdrawals. Next, since the major focus is on students affected by the strike, the extent of data available for them is considered. Finally the general effects of year and school board are presented since these affect the dependent variables.

Sample and Rejection Rates

The data were drawn from student records at Laurentian University. There were a number of difficulties associated with the transfer of the data to the computer analysis program used. A large number of records also had to be altered in format to access the correct fields. Still, however, a number of records in each year had to be rejected as erroneous. Table 3.1 shows the absolute number of bad records for each year, the original total, and the error percentage rate.

Chapter 3
Preliminary Statistical Analysis

Table 3.1

Rejection Rates for Student Records by Year

Year	No. of student records	Rejected records	%of Usable Records
1976	681	6	99.12
1977	586	3	99.49
1978	579	4	99.31
1979	526	2	99.62
1980	538	2	99.63

It can be seen that the spoilage rate was small enough not to significantly affect any of the analysis. For all intents and purposes, then, we are dealing with a population rather than a sample.

General Characteristics of the Sample

The three following tables show the relationships between year of registration and sex, language and school board. Table 3.2 shows that the sex ratio over the period was more or less constant with more females attending university than males.

Table 3.2

Sex and Year of Students

	Percent Female	Percent Male	N
1976	58	42	(681)
1977	59	42	(583)
1978	53	48	(575)

1979	57	43	(525)
1980	59	41	(536)
Total Ns	1648	1252	2900

(Note: Ns on which percentages have been calculated are enclosed in parentheses.)

Table 3.3 shows that the percentage of students describing their language as English was also relatively constant over the period.

Table 3.3

Year and Language of Students

	Percent French	Percent English	N
1976	17	83	(681)
1977	20	80	(583)
1978	17	83	(575)
1979	19	81	(525)
1980	19	82	(536)
Total Ns	526	2374	2900

Table 3.4 shows that the proportion of students from the Sudbury school board did not change greatly.

Table 3.4

Year and School Board of Students

	Sudbury	Other	N
1976	31	69	(681)
1977	36	65	(583)

1978	34	66	(575)
1979	36	64	(525)
1980	31	69	(536)
Total Ns	964	1936	2900

The column of Ns on these tables also shows that the number of students declined somewhat over the period.

Description of Independent Variables

The independent variables used in the study were limited to those which are routinely recorded by the Office of the Registrar. There are six variables for which complete information was available. These include YEAR, LANG, SEX, YOB, SUDBURY, and STRIKE. Table 3.5 shows the means, standard deviations, and numbers for these variables.

Table 3.5

Means and Standard Deviations for Independent Variables

	Mean	Standard Deviation	Number
YEAR	2.88	1.43	2900
LANG	.82	.39	2900
SEX	.43	.01	2900
YOB	58.9	1.67	2900
SUDBURY	.27	.44	2900
STRIKE	.05	.21	2900
GR12	73.9	7.62	1529
GR13	80.9	8.60	1499

YEAR refers to the year in which a student first

registered at Laurentian. This varied from 1976 to 1980, but was coded from 1 through 5. The actual distribution has already been shown in Table 3.1.

LANG refers to preferred language of instruction. In student records this was listed as E for English or F for French. It was recoded 0 for French and 1 for English. The actual distribution was shown in Table 3.3.

SEX in the student records was M or F and was recoded to be 0 for females and 1 for males. The actual distribution by YEAR was shown in Table 3.2.

YOB is year of birth and refers to the year of birth of the student. It was coded using the last two digits of the year.

SUDBURY was a variable derived from the records showing which secondary school the student had attended. It was coded as 1 for all schools within the jurisdiction of the Sudbury Board of Education and 0 for all others. Those interested in the results for the area should note that students from separate schools in Sudbury were coded 0. The actual distribution was shown in Table 3.4.

STRIKE is the variable which is most important for this study. It had to include all the students who were affected by the Sudbury teachers' strike. All students scoring 5 on YEAR and 1 on SUDBURY were given a code of 1 for STRIKE. All other students received a code of 0 for STRIKE. There were 134 students in the sample affected by the strike.

For the last two independent variables, GR12 and GR13, data were not available on all student records. GR12 was the

average of the student's grade 12 marks. In the student records it was stored in F3.1 format. GR13 was the average of grade 13 subjects taken insofar as this could be calculated from the records. The records contained grades from up to six subjects taken. The grades were added up and then divided by the number of grades to give a value for each respondent on GR13.

Table 3.6 shows the Pearson product-moment correlations between the independent variables employed in the study. Since these were obtained using pairwise deletions of missing values, the number on which the correlation was calculated is included beneath the correlation coefficient.

Table 3.6

Correlations Between Independent Variables

	1	2	3	4	5	6	7	8
1 GR13	1.000 1499	0.693 796	0.123 1499	-0.038 1499	-0.201 1499	0.166 1499	0.063 1499	0.037 1499
2 GR12		1.000 1529	0.038 1529	-0.080 1529	-0.227 1529	0.126 1529	-0.020 1529	-0.001 1529
3 YEAR			1.000 2900	-0.008 2900	-0.001 2900	0.860 2900	0.326 2900	0.005 2900
4 LANG				1.000 2900	0.118 2900	-0.048 2900	0.023 2900	0.067 2900
5 SEX					1.000 2900	-0.057 2900	0.010 2900	0.079 2900
6 YOB						1.000 2900	0.281 2900	-0.015 2900
7 STRIKE							1.000 2900	0.366 2900
8 SUDBURY								1.000 2900

Chapter 3
Preliminary Statistical Analysis

Description of Dependent Variables

The dependent variables all concern the student's performance in the first year of university. Student record data shows up to ten courses or half-courses along with a numerical grade or an F for failure, a WDR for withdrawal, or an A for audit. The subject codes and their meanings are presented in Table 3.7.

Table 3.7

Letter Codes For Courses

Code	Meaning
ACCT	Accounting
ANGL	Anglais (English for French-Canadians)
ANTR	Anthropology
ASTR	Astronomy
BIOL	Biology
CANA	Canadian Studies
CHMI	Chemistry
CLAS	Classical Studies
COMM	Commerce
COSC	Computer Science
DEUT	German
ECON	Economics
EDUC	Education
ENGL	English
ENGR	Engineering
ESPA	Spanish
ESTD	Environmental Studies

FINA	Fine Arts
FOLK	Folklore
FRAN	Francais
FREN	French
GEOG	Geography
GEOL	Geology
GREC	Greek
GSCI	General Science
HIST	History
INFO	Informatique
INTE	Interdisciplinary Studies
ITAL	Italian
JURI	Law and Justice
LATN	Latin
LING	Linguistic
MATH	Mathematics
MUSC	Music
NATI	Native Studies
NURS	Nursing
PHED	Physical Education
PHIL	Philosophy
PHYS	Physics
POLI	Political Science
PSYC	Psychology
RLST	Religious Studies
RUSS	Russian
SOCI	Sociology

SPAD	Sports Administration
SREL	Sciences Religieuses
SUOM	Finnish
SWLF	Social Welfare
THEA	Theatre Arts
TRAN	Translation
VISA	Visual Arts
WOMN	Women's Studies

Since departments are divided into the four Faculties of Natural Science, Social Science, Arts, and Professional Schools, the measures used were aggregated for each Faculty to provide summary statistics. The allocation of subjects to Faculties is shown in Table 3.8.

Table 3.8

Courses Classified in Different Faculties

Faculty	Course	Faculty	Course
Natural	ASTR	Social	ANTR
Science	BIOL	Science	ECON
	CHMI		GEOG
	COSC		HIST
	ENGR		POLI
	GEOL		PSYC
	MATH		SOCI
	PHYS		

Faculty	Course	Faculty	Course
Arts	ANGL	Professional	ACCT
	CLAS	Schools	COMM
	DEUT		EDUC
	ENGL		NURS
	ESPA		PHED
	FRAN		SPAD
	FREN		SWLF
	GREC		TRAN
	ITAL		
	LATN		
	LING		
	PHIL		
	RUSS		
	SUOM		

Some of the subjects listed in Table 3.7 were not allocated to Faculties because they were indisciplinary, difficult to classify, or special in some other respect.

In addition, there was an overall summary for each measure. For this, all subjects were included.

Marks

Each student is assigned an average for a subject area based on the one or more marks he or she received for courses taken in that subject area equal to or greater than 50%. No failing grades are included. Table 3.9 gives the arithmetic means, standard errors, and numbers for the subjects taken.

Table 3.9

Marks for Subject Areas

Subject	Mark	Standard Deviation	Number
ACCT	70.3	10.7	45
ANGL	63.6	6.3	10
ANTR	73.3	9.8	68
ASTR	74.1	10.9	47
BIOL	67.5	9.7	528
CANA	67.9	7.0	87
CHMI	70.6	11.2	488
CLAS	71.7	7.6	56
COMM	69.3	9.6	705
COSC	71.6	12.7	438
DEUT	77.2	9.4	111
ECON	69.2	9.6	894
EDUC	74.2	4.2	137
ENGL	67.1	8.0	858
ENGR	68.7	9.3	120
ESPA	76.9	8.7	160
ESTD	64.8	10.4	19
FINA	68.0	5.7	2
FOLK	72.0	5.8	9
FRAN	70.6	6.8	289
FREN	74.1	7.6	338
GEOG	70.4	8.2	273
GEOL	69.8	9.4	130

GREC	69.5	13.4	2
GSCI	68.8	11.4	4
HIST	69.8	7.4	333
INFO	87.3	6.4	6
INTE	70.6	3.6	7
ITAL	78.8	10.2	111
JURI	68.9	7.9	167
LATN	70.0	0.0	1
LING	76.1	5.8	30
MATH	69.4	12.1	520
MUSC	70.5	8.9	22
NATI	68.7	7.6	40
NURS	70.7	6.8	118
PHED	74.0	6.4	351
PHIL	70.4	8.6	293
PHYS	67.0	11.3	384
POLI	70.9	8.5	503
PSYC	71.0	10.0	1360
RLST	72.2	5.1	124
RUSS	72.7	13.9	18
SOCI	69.4	7.6	992
SPAD	67.6	7.1	146
SREL	67.6	7.2	13
SUOM	79.5	5.1	4
SWLF	74.2	6.4	261
THEA	74.0	7.0	3

TRAN	73.5	6.3	222
VISA	68.8	10.8	4
WOMN	69.6	5.9	12

The marks for different faculties are contained in Table 3.10 under the labels NATMARK, SOCMARK, ARTMARK, AND PROMARK. Finally, as a gross summary measure, the student's overall average was calculated. It too is included in Table 3.10 as ALLMARK.

Table 3.10

Overall and Faculty Marks

	Mark	Standard Deviation	Number
ALLMARK	70.2	7.2	2781
NATMARK	68.9	10.8	1285
SOCMARK	70.1	8.3	2180
ARTMARK	69.9	8.3	1544
PROMARK	71.7	7.6	1660

Failures

Since we did not include marks lower than 50% in the analysis and since students could have received an F for their grade on a course, it is important to include failures as a dependent variable.

The dependent variable in this section is zero for a student who has no failures among the classified subjects and

one for a student who has failed one or more courses. It is important to note that a student has to fail only one course to become classed as a failure. For example, if a student fails Introductory Sociology, he or she will receive a score of 1 for SOCIF, a score of 1 for SOCFAIL, and a score of 1 for ALLFAIL, regardless of how he or she did on other social science or sociology courses. An implication of this is that one and the same student could score 80 in BIOL and yet be scored 1 for BIOLF by taking two Biology courses and failing one and getting 80% in the other. This method was adopted rather than using number of failures as a variable, since there were relatively few students failing more than one course and the focus of interest was on what makes a student fail initially.

It is unfortunate but some of the failures will result from administrative actions. That is, a student who decides to withdraw near the conclusion of a course will receive an F in that course. Hence, even if he dropped out, he will still be classed as a failure. This means that students who try their exams and fail are classed together with those who drop out. This however is a general university practice. Students who applied to withdraw earlier on in the year and who consequently are assigned a WDR are not counted as failing.

Table 3.11 shows the percentage of failures for each subject as well as the number of students on which it is based. In each case, the number of students will be equal to or greater than the number on which the mark was based. The

standard deviation is based on a scoring of 0 for passing all courses and 100 for failing.

Table 3.11

Percent Failing Specific Subjects

Subject	% Failing	Standard Deviation	Number
ACCTF	15.1	36.1	53
ANGLF	9.1	30.2	11
ANTRF	5.6	23.1	72
ASTRF	4.1	20.0	49
BIOLF	6.3	24.4	553
CANAF	7.4	26.4	94
CHMIF	13.0	33.6	563
CLASF	3.4	18.4	58
COMMF	12.2	32.8	800
COSCF	10.9	31.2	487
DEUTF	2.6	16.1	114
ECONF	6.4	24.4	974
EDUCF	2.1	14.5	140
ENGLF	7.3	26.1	929
ENGRF	8.7	28.2	127
ESPAF	1.2	11.1	162
ESTDF	13.6	35.1	22
FINAF	0.0	0.0	2
FOLKF	0.0	0.0	9
FRANF	4.7	21.2	297
FRENF	2.0	14.2	342
GEOGF	4.2	20.1	285

GEOLF	8.4	27.8	143
GRECF	0.0	0.0	2
GSCIF	0.0	0.0	4
HISTF	5.1	22.1	351
INFOF	0.0	0.0	6
INTEF	0.0	0.0	7
ITALF	4.3	20.4	116
JURIF	9.7	29.7	185
LATNF	0.0	0.0	1
LINGF	0.0	0.0	30
MATHF	16.1	36.7	604
MUSCF	20.0	40.8	25
NATIF	2.4	15.6	41
NURSF	.8	9.2	119
PHEDF	5.6	23.1	356
PHILF	6.4	24.5	313
PHYSF	15.4	36.1	448
POLIF	4.2	20.1	525
PSYCF	5.9	23.5	1445
RLSTF	2.4	15.2	127
RUSSF	5.3	22.9	19
SOCIF	4.2	20.1	1041
SPADF	3.3	18.0	151
SRELF	0.0	0.0	13
SUOMF	0.0	0.0	4
SWLFF	2.6	16.0	268
THEAF	0.0	0.0	3

TRANF	3.1	17.5	223
VISAF	0.0	0.0	4
WOMNF	7.7	27.7	13

As with marks, these failure rates were considered by faculty division and overall. Table 3.12 shows the failure rates for all subjects, natural science subjects, social subjects, arts subjects, and professional school subjects labelled as ALLFAIL, NATFAIL, SOCFAIL, ARTFAIL, and PROFAIL. Note again that it only takes one failure to be counted as failing, so that the highest percentage should be that for ALLFAIL.

Table 3.12

Overall and Faculty Percentages of Students Having Failed

	% Failing	Standard Deviation	Number
ALLFAIL	18.4	38.8	2828
NATFAIL	17.7	27.7	1362
SOCFAIL	8.2	27.5	2255
ARTFAIL	6.7	25.0	1628
PROFAIL	8.1	27.3	1751

The table shows that there is a higher failure rate in Natural Sciences than in the other faculties.

Withdrawals

Some students withdrew from courses too soon to actually fail. In fact, 72 students withdrew from all their courses. Although originally we intended to count withdrawing from a

course as similar to failing, there was some argument that the reasons for withdrawal were much more varied, and that, in consequence, it had better be treated as a separate category. Presenting the data on withdrawals separately allows the reader to decide whether or not to consider withdrawals along with failures on the basis of the data.

Withdrawals are measured in the same way as failures. If a student withdraws from one course in any subject, he counts as withdrawing in that subject, in the faculty subsuming that subject, and overall. This means that if a student took three courses in one subject, he or she could get a mark, fail, and withdraw in that subject. Table 3.13 presents withdrawal rates for each subject.

Table 3.13

Percent Withdrawing from Specific Subjects

	% Withdrawing	Standard Deviation	Number
ACCTW	8.6	28.3	58
ANGLW	0	0	11
ANTRW	5.3	22.5	76
ASTRW	7.5	26.7	53
BIOLW	4.7	21.1	578
CANAW	2.1	14.4	96
CHMIW	5.5	22.9	595
CLASW	7.9	27.2	63
COMMW	8.4	27.7	862
COSCW	6.8	25.1	517
DEUTW	5.8	23.4	121

ECONW	4.0	19.7	1015
EDUCW	6.0	23.9	149
ENGLW	6.8	25.2	988
ENGRW	2.3	15.1	130
ESPAW	8.5	27.9	177
ESTDW	4.3	20.9	23
FINAW	33.3	57.7	3
FOLKW	0	0	9
FRANW	4.0	19.6	301
FRENW	4.5	20.8	354
GEOGW	6.9	25.4	305
GEOLW	8.3	27.7	156
GRECW	0	0	2
GSCIW	0	0	4
HISTW	4.9	21.6	369
INFOW	0	0	6
INTEW	0	0	7
ITALW	3.3	18.0	120
JURIW	6.3	24.0	197
LATNW	0	0	1
LINGW	3.2	18.0	31
MATHW	5.9	23.5	632
MUSCW	7.4	26.7	27
NATIW	2.4	15.4	42
NURSW	4.8	21.5	125
PHEDW	3.3	18.0	359
PHILW	5.7	23.3	332

PHYSW	8.8	28.4	487
POLIW	3.5	18.4	544
PSYCW	3.2	17.5	1492
RLSTW	4.5	20.9	132
RUSSW	5.0	22.4	20
SOCIW	3.1	17.3	1074
SPADW	0	0	151
SRELW	7.1	26.7	14
SUOMW	0	0	4
SWLFW	2.9	16.8	276
THEAW	25.0	50.0	4
TRANW	3.1	17.4	225
VISAW	0	0	4
WOMNW	7.1	26.7	14

Table 3.14 shows the overall withdrawal rate, ALLWITH, and the rates for the different faculties, NATWITH, SOCWITH, ARTWITH, and PROWITH.

Table 3.14

Overall and Faculty Percentages of Students Withdrawing

	% Withdrawing	Standard Deviation	Number
ALLWITH	12.6	33.2	2900
NATWITH	9.2	29.0	1419
SOCWITH	5.3	22.4	2332
ARTWITH	7.0	25.5	1699
PROWITH	6.5	24.7	1828

Chapter 3
Preliminary Statistical Analysis

Extent of Data for Strike Students

Our analysis ultimately is concerned with the relative characteristics of those who were affected by the Sudbury school strike. In consequence, for each of the grade variables it is also important to note what the average of those affected by the strike was, and for how many students the data were available. This information is contained in Table 3.15.

Table 3.15

Average Grades for Strike Students

	Average Grade	Standard Error	N
Grade 12	73.1	9.89	63
Grade 13	83.7	1.08	52
All subjects	71.6	.67	128
Natural sciences	73.1	1.30	93
Social sciences	71.7	.80	109
Professional schools	71.2	.88	73
Arts	74.7	1.12	53

(Note: The total number of strike students was 165.)

It can be seen that there are still sufficient cases for some kinds of comparison. Problems however arise when one attempts to cross-classify Laurentian marks with grade 12 and grade 13 marks within the group affected by the strike.

Chapter 3
Preliminary Statistical Analysis

Number and Grades of Strike Students With Missing High School Data

Since there are a number of students with missing grades for grades twelve and thirteen, it is appropriate to investigate whether those students with marks on the covariates (grades twelve and thirteen) differ from those without in their averages on the dependent variables. Table 3.16 shows scores on the outcome variables classified by presence of grade 12 and 13 marks.

Table 3.16

Faculty Grades by Data on High School Marks

for Strike Students Only

All Subjects

	without grade 13	with grade 13	all
without grade 12	71.0 (35)	73.0 (32)	71.9 (67)
with grade 12	70.8 (44)	72.1 (17)	71.2 (61)
all	70.9 (79)	72.6 (49)	71.6 (128)

Natural Sciences

	without grade 13	with grade 13	all
without grade 12	74.5 (23)	73.7 (16)	74.2 (39)
with grade 12	70.9 (27)	74.5 (13)	72.1 (40)
all	72.6 (50)	74.1 (29)	73.1 (79)

Social Sciences

	without grade 13	with grade 13	all
without grade 12	71.4 (30)	73.3 (26)	72.3 (56)
with grade 12	70.7 (38)	72.2 (15)	71.1 (53)
all	71.0 (68)	72.9 (41)	71.7 (109)

Professional Schools

	without grade 13	with grade 13	all
without grade 12	69.8 (21)	71.9 (17)	70.7 (38)
with grade 12	71.6 (24)	72.3 (11)	71.8 (35)
all	70.8 (45)	72.0 (28)	71.2 (73)

Arts

	without grade 13	with grade 13	all
without grade 12	72.6 (14)	74.8 (17)	73.8 (31)
with grade 12	76.6 (14)	74.6 (8)	75.9 (22)
all	74.6 (28)	74.7 (25)	74.7 (53)

This table also shows the smaller Numbers of students affected by the strike who have both grade twelve and grade thirteen scores, varying from 10 for arts to 23 for social sciences.

Chapter 3
Preliminary Statistical Analysis

The Effects of Time

One characteristic of university grades is that they have changed over time. This can be shown in Table 3.17.

Table 3.17

Overall and Faculty Marks by Year

	YEAR				
	76	77	78	79	80
ALLMARK	67.9	70.1	70.6	71.5	71.6
N	663	542	547	514	515
NATMARK	67.6	67.3	67.5	70.5	70.6
N	280	215	276	248	266
SOCMARK	66.9	70.0	70.9	72.1	71.5
N	509	389	437	415	421
ARTMARK	66.3	69.0	71.5	72.0	72.8
N	407	313	300	275	249
PROMARK	70.6	72.0	71.6	72.6	72.0
N	368	302	347	316	327

The table shows that marks increased over the period.

Table 3.18 presents failure rates broken down by division and by year of entry. On balance failure rates declined over the period, particularly in natural sciences.

Table 3.18

Faculty Percentages of Students Failing by Year

	YEAR				
	76	77	78	79	80
ALLFAIL	18.6	19.5	16.6	18.0	19.3
N	671	553	560	522	522

NATFAIL	18.5	21.2	17.0	15.8	16.4
N	297	231	294	260	280
SOCFAIL	10.6	10.4	7.0	5.9	6.9
N	529	413	455	424	434
ARTFAIL	6.5	8.7	5.7	4.9	7.5
N	430	335	315	283	265
PROFAIL	5.7	5.8	8.0	10.7	10.5
N	387	309	364	337	354

The result of the above discussion is to show that marks inflated over the period and failures showed an uncertain trend.

Table 3.19

Faculty Percentages of Students Withdrawing by Year

	YEAR				
	76	77	78	79	80
ALLWITH	11.6	14.6	13.4	9.7	13.6
N	681	583	575	525	536
NATWITH	8.2	11.7	10.4	5.6	10.2
N	306	247	307	266	293
SOCWITH	4.6	7.1	6.9	3.7	4.3
N	542	436	475	433	446
ARTWITH	5.6	8.9	8.4	5.5	6.5
N	443	358	332	290	276
PROWITH	5.3	10.1	5.6	4.9	7.0
N	397	335	378	346	372

Chapter 3
Preliminary Statistical Analysis

The Effects of School Board

Table 3.20 shows the relative marks of students from Sudbury schools and those from other schools.

Table 3.20

Overall and Faculty Marks by School Board

	SUDBURY	Not from SUDBURY
ALLMARK	70.0	70.3
N	734	2047
NATMARK	69.9	68.5
N	412	873
SOCMARK	70.5	70.0
N	586	1594
ARTMARK	70.4	69.8
N	359	1185
PROMARK	70.8	71.7
N	396	1264

Sudbury students tended to do slightly better in all faculties except that of Professional Schools, although overall marks were similar.

Table 3.21 shows failure rates compared to origin.

Table 3.21

Faculty Percentages of Students Failing by School Board

	SUDBURY	Not from SUDBURY
ALLFAIL	20.4	17.7
N	750	2078
NATFAIL	18.4	17.4
N	435	927

SOCFAIL	8.9	8.0
N	610	1645
ARTFAIL	7.1	6.6
N	382	1246
PROFAIL	10.2	7.4
N	422	1329

Sudbury students are more likely to fail in each faculty. However this may well be because more marginal students from Sudbury attend university than from other areas.

Table 3.22

Overall and Faculty Percentages of Students Withdrawing by School Board

	SUDBURY	Not from SUDBURY
ALLWITH	13.7	12.2
N	771	2129
NATWITH	8.9	9.4
N	450	969
SOCWITH	6.0	5.1
N	631	1701
ARTWITH	6.5	7.2
N	403	1296
PROWITH	8.1	6.0
N	446	1382

Sudbury students are slightly more likely to withdraw than other students.

Chapter 3
Preliminary Statistical Analysis

Summary

This chapter has described the sampling procedure and the students selected. It presented the independent variables as well as characteristics related to their distribution. The dependent variables were considered in more detail. The most important finding was that YEAR affects marks with students entering in later years gaining higher grades. However YEAR was also shown to affect failures. The effects of school board on failures were also considered.

The next chapter will look at the influence of the independent variables on grades.

Chapter Four

Statistical Analysis of Marks

Introduction

This chapter considers the effect of strike on the marks achieved by students in their first year at Laurentian. Only marks equal to or greater than 50% are considered. First strike and non-strike students are compared in terms of their average grades. Then other factors are controlled through multivariate analysis.

The Effects of the Strike on Grades

Here we present the mean grade achieved by students who were affected by the strike and that of those not so affected. However, we know from the last chapter that grades increased over the period so it may be important to compare only those students who came in the last year, 1980. Since the 1980 non-strike students all came from outside Sudbury, Table 4.1 includes data on all non-strike students and also on 1980 non-strike students. These are to be compared with mean marks for strike students.

Table 4.1

Subject Marks of Strike Students and Others

	All				1980	
	Non-strike		Strike		Non-strike	
	%	N	%	N	%	N
ACCT	70.3	45		0	68.3	8
ANGL	63.6	10		0	65.0	1

ANTR	73.2	63	75.2	5	75.5	8
ASTR	74.5	44	68.3	3	80.0	1
BIOL	67.4	505	69.9	23	70.5	81
CANA	67.9	87		0	71.4	5
CHMI	70.5	463	72.2	25	70.6	87
CLAS	71.5	53	76.3	3	72.1	7
COMM	69.2	658	70.7	47	68.7	115
COSC	70.8	396	78.4	42	72.5	73
DEUT	77.2	106	76.0	5	81.8	19
ECON	69.1	834	69.8	60	70.0	132
EDUC	74.2	137		0	77.6	15
ENGL	66.9	834	71.9	24	67.2	84
ENGR	68.5	116	75.6	4	69.9	15
ESPA	77.0	156	75.5	4	75.7	26
ESTD	64.8	19		0	68.0	5
FINA	68.0	2		0		0
FOLK	72.0	9		0	71.5	1
FRAN	70.6	286	70.3	3	72.0	49
FREN	74.0	326	78.5	12	79.6	45
GEOG	70.3	264	75.6	9	71.3	20
GEOL	69.5	123	74.7	7	73.1	7
GREC	69.5	2		0		0
GSCI	67.0	3	74.0	1	64.5	2
HIST	69.8	319	69.4	14	69.9	33
INFO	87.3	6		0	87.8	5
INTE	70.6	7		0		0
ITAL	78.4	102	84.0	9	78.7	19

JURI	69.2	146	66.7	21	69.5	32
LATN	70.0	1		0		0
LING	76.1	30		0	74.7	7
MATH	69.4	492	68.0	28	71.6	63
MUSC	70.1	21	78.0	1	74.2	6
NATI	68.7	40		0	73.3	12
NURS	70.9	112	67.2	6	73.1	18
PHED	74.1	343	72.2	8	76.7	53
PHIL	70.2	281	75.9	12	74.0	34
PHYS	66.9	369	69.0	15	69.9	47
POLI	70.7	472	73.6	31	73.8	62
PSYC	70.9	1295	73.1	65	71.6	222
RLST	72.0	116	75.5	8	74.6	17
RUSS	71.9	16	79.0	2	86.0	1
SOCI	69.4	953	68.7	39	70.5	152
SPAD	67.5	143	70.7	3	68.3	26
SREL	72.9	13		0		0
SUOM	79.5	4		0		0
SWLF	74.2	254	73.7	7	74.2	46
THEA	74.0	3		0	74.0	3
TRAN	73.5	214	74.2	8	73.7	1
VISA	68.8	4		0		0
WOMN	70.3	10	66.0	2	70.0	1

First note that the All-non-strike column tends to show lower grades than the strike column. However, as shown in the last chapter, grades did increase over the period. Consequently the table has been presented so that it is also possible to

compare the 1980 non-strike students with strike students.

Some predictions cited in Chapter Two emphasized Natural Sciences. Considering only those with sufficient students, non-strike students did better in Mathematics, slightly better in Biology, the same in Physics, and worse in Computer Science, Geography and Geology. Among other large-enrolment subjects, strike students did better in Commerce, English, and Psychology, but worse in the Law program and Sociology.

Table 4.2 summarizes the same results for overall grades and for each faculty.

Table 4.2

Faculty Grades for Strike and Non-strike Students

	All				1980	
	Non-strike		Strike		Non-strike	
	%	N	%	N	%	N
ALLMARK	70.2	2653	71.6	128	71.7	387
NATMARK	68.7	1206	73.1	79	71.0	187
SOCMARK	70.0	2071	71.7	109	71.4	312
ARTMARK	69.7	1491	74.7	53	72.3	196
PROMARK	71.8	1587	71.2	73	72.3	254

Again, on the whole, strike grades are better than all-non-strike grades except for Professional Schools. Strike grades are higher than 1980 non-strike grades in Natural Science and Professional Schools, but lower in Arts. Overall grades are the same in 1980 between strike and non-strike students.

Chapter 4
Statistical Analysis of Marks

The Necessity for Multivariate Analysis

The fact that average grades for strike students were higher than those for the total sample in natural sciences and arts might seem to indicate no possible negative effect from the strike. It does mean that students affected by the strike were not generally worse in marks than the average student. But it would be an inappropriate measure for a number of reasons.

First, there has been a process of grade inflation. We saw in Table 3.7 that grades at Laurentian rose by about 2% over the period. At the beginning of the period, the grading scheme at Laurentian was reclassified and the cutoff grade for A's raised from 75% to 80%. Consequently one would expect later students to do better than earlier students. Perhaps those affected by the strike, though having a higher mean grade than other students, would have done even better had they not experienced the strike.

Another consideration affecting the argument is that Sudbury-origin students tended to do somewhat better than students from other areas. In fact the results here reproduce the general distribution of Sudbury-nonSudbury marks which was outlined in Table 3.13. This again argues against a simple comparison of mean grades.

A final reason is hypothetical. There are every year fluctuations in high school marks. If we want a realistic characterization of the effects of the strike, it is important to make sure that any random fluctuations in student abilities are ironed out so that they do not affect

the comparisons.

All these reasons argue for the use of some form of multivariate analysis to reduce the influence of such confounding factors as we have mentioned. The most flexible and general model is that of regression analysis. The remainder of this chapter will present a regression analysis of student grades. The aim of the analysis is to discover the impact of the strike as a variable affecting grades. In order to do this all other variables are considered simultaneously.

Correlations Underlying Regressions

It is instructive, prior to the analysis to present the correlations of the dependent variables with the independent variables. Table 4.3 shows the number of cases involved as well as the relative magnitudes of the first-order correlations between the independent variables and the dependent variables.

Table 4.3

Correlations Between Independent and Dependent Variables

	ALLMARK	NATMARK	SOCMARK	ARTMARK	PROMARK
GR13	0.572 1444	0.506 734	0.528 1110	0.519 794	0.371 859
GR12	0.580 1469	0.491 660	0.518 1175	0.526 830	0.396 899
YEAR	0.180 2900	0.145 1285	0.205 2180	0.278 1544	0.067 1660
LANG	-.073 2781	-.052 1285	-.018 2180	-.079 1544	-.054 1660

SEX	-.197	-.084	-.146	-.201	-.179
	2781	1285	2180	1544	1660
YOB	0.212	0.157	0.226	0.302	0.078
	2781	1285	2180	1544	1660
STRIKE	0.040	0.099	0.044	0.108	-.014
	2781	1285	2180	1544	1660
SUDBURY	-.016	0.058	0.025	0.035	-.064
	2781	1285	2180	1544	1660

The first two variables, Grade 13 and Grade 12 marks, show the highest correlation with university marks.

The Methods of Analysis

One method of analyzing the effect of category-membership, like being affected by the strike, on a dependent variable, like grades in natural science, is to enter the data into a regression equation. In effect, this estimates the relative importance of each of a set of independent variables in predicting or explaining the dependent variable. In this specific case, this means that if the strike had a significant effect on students' grades, three results should occur. First, a stepwise regression should select STRIKE (being affected by the strike) for inclusion in the regression equation. Second, the standardized beta coefficient in the equation representing the influence of STRIKE should be sufficiently large. Third, any equation including the influence of STRIKE should explain significantly more variance in the dependent variable than any equation excluding the influence of STRIKE.

Problems with Using Regression

Pedhazur (1982) argues that if there are high correlations among the independent variables, there will be difficulty with the interpretation of the regression coefficient as an indicator of the relative weight of a specific causal factor. Mosteller and Tukey (1977) are even clearer on this issue showing that a perfect correlation between independent variables leads to indeterminate regression coefficients. For essentially this reason, Pedhazur appears to forswear the use of regression to establish relative validity.

It is obvious to all statisticians, and should be better known among other researchers, that there are always a set of models compatible with any given set of data. Duncan (1975) recommends that a model be specified. In this case, however, the issue is not explaining grades, failures, or withdrawals, but rather the somewhat different question of evaluating the role of STRIKE in the determination of these. For these purposes the only main model-related assumption which is necessary is that ability has a more direct influence on grades than STRIKE and that ability is reasonably measured by Grade 13 marks. This assumption allows us to remove the influence of Grade 13 prior to looking at the effects of STRIKE. It also serves to deflect the kinds of criticism which Pedhazur would make.

An additional target for attack is the fact that a number of the variables are categorical. Strictly speaking, regression analysis should be applied only to continuous

variables. It is therefore important to note that the requisite assumptions may not be met in this case. However it is frequently used in this type of context, and represents a much more powerful method of analysis than its competitors.

Stepwise Regression after controlling for Grade Thirteen

A problem of some frequency arises, however, when the independent variables are themselves strongly correlated. This makes the relative influence of each somewhat indeterminate. In our analysis, invariably the most important factor affecting grades was the student's average grade 13 mark. For the regression on each division, it was selected first and had the highest standardized regression coefficient or beta. For natural sciences and social sciences, the order of selection was grade 13 mark, year, and grade 12 mark whereas for professional schools and arts the order was grade 13 mark and then grade 12 mark. However, when the grade 12 mark was later entered into the equation, the beta for the grade 13 mark substantially declined. The ideal solution to the multicollinearity problem in this case was to assign the maximum causal influence to the grade 13 mark since it is temporally closer.

The practical implementation of this procedure involved for each student calculating the deviation from the expected score based on grade 13 mark given the regression for each student. The values of the relevant parameters calculated from the initial regression are shown in Table 4.4.

Table 4.4

Parameters of the Regression of Grade 13 on Faculty Mark

	Constant	Unstandardized B (S.E.)	Beta
ALLMARK	31.307	.481(.018)	.572
NATMARK	17.426	.637(.040)	.506
SOCMARK	28.845	.510(.025)	.528
ARTMARK	29.401	.501(.029)	.519
PROMARK	45.116	.329(.028)	.371

For each student, the expected value is subtracted from the actual value and this deviation score is the basis for the next analysis. The variables included in the regression equation and their betas as well as the beta for strike if it had been included are presented in Table 4.5.

Table 4.5

Regression of Deviations from Marks Predicted by Grade 13 on Other Included Variables and Strike

	ALLMARK Deviations as Dependent Beta or Standardized Regression Coefficient
YEAR	.133
LANG	-.075
SEX	-.056
STRIKE	-.017

	NATMARK Deviations as Dependent
	Beta
YEAR	.136
STRIKE	.035
	SOCMARK Deviations as Dependent
	Beta
YEAR	.132
STRIKE	-.014
	ARTMARK Deviations as Dependent
	Beta
YEAR	.278
LANG	-.132
SEX	-.086
STRIKE	-.014
	PROMARK Deviations as Dependent
SUDBURY	-.073
LANG	-.071
STRIKE	-.012

In no case was strike included by the program. In the case of deviations from the mean for professional schools, no variables were entered. The fact that the betas for strike were all insignificant shows that strike did not have much influence on grades in any of the divisions.

Thus it is apparent that the first two expected results of strike's importance did not materialize. Stepwise regressions did not select strike as a significant variable.

And the standardized beta coefficients in the equations for strike were not large.

Comparing Multiple Correlations between Regression Equations

The third method of considering the importance of a variable is based on the variable's overall role in altering the regression equation. Basically one compares two alternative models which are identical save for the presence of the variable of interest. The contribution of the variable is then measured by the change in the square of the multiple correlation coefficient. Here we compared two regression models for each division, one with grade 13, year, and strike as predictors, and one with only grade 13 and year as predictors. Table 4.6 contains the results.

Table 4.6

R-Squared Change from Adding Strike to a Two-Variable Model Predicting Marks

	R squared for three variable model	R squared for two variable model	Difference
ALLMARK	.340	.339	.001
NATMARK	.265	.255	.010
SOCMARK	.300	.298	.002
ARTMARK	.321	.309	.012
PROMARK	.141	.140	.001

The change in the R squared is quite small in all cases. The

largest influences are in natural science and arts. Table 4.7 shows a similar situation for a four-variable model.

Table 4.7

R-Squared Change from Adding Strike to a Three-Variable Model Predicting Marks

	R squared for four variable model	R squared for three variable model	Difference
ALLMARK	.341	.339	.002
NATMARK	.265	.255	.010
SOCMARK	.301	.299	.002
ARTMARK	.321	.310	.011
PROMARK	.145	.145	.000

Again, the model shows little change in R-Squared. The largest change is in Natural Science.

Comparing Betas in Regression Equations

Table 4.8 shows betas for four different models, all constrained to include strike.

Table 4.8

Standardized Regression Coefficients or Betas for More Complete Models

	ALLMARK			
	No. of variables			
	6	4	3	2
GR13	.541	.560	.559	.571
YEAR	.121	.119	.123	

SUDBURY	-.018	-.029		
SEX	-.081			
LANG	-.040			
STRIKE	-.025	-.023	-.035	.004

NATMARK

	No. of variables 6	4	3	2
GR13	.496	.494	.495	.502
YEAR	.072	.073	.069	
SUDBURY	.028	.027		
SEX	.018			
LANG	-.037			
STRIKE	.035	.035	.045	.068

SOCMARK

	No. of variables 6	4	3	2
GR13	.501	.511	.512	.528
YEAR	.159	.158	.155	
SUDBURY	.027	.023		
SEX	-.048			
LANG	.007			
STRIKE	-.049	-.048	-.039	.011

ARTMARK

	No. of variables 6	4	3	2
GR13	.467	.491	.491	.514
YEAR	.233	.230	.228	

SUDBURY	.030	.017		
SEX	-.104			
LANG	-.049			
STRIKE	-.006	-.004	.003	.076

	PROMARK			
	No. of variables			
	6	4	3	2
GR13	.352	.372	.370	.374
YEAR	.031	.029	.038	
SUDBURY	-.060	-.070		
SEX	-.092			
LANG	-.025			
STRIKE	-.023	-.021	-.050	-.037

This table shows that in the case of natural science, the school strike appears to have increased students' grades. Obviously this must be a spurious correlation but it does clearly show that the school strike could not have had any large negative effect.

Summary

The results presented show that the average grades of students affected by the strike do not differ from those who were not affected. That is to say experience of the strike did not adversely influence student grades at Laurentian.

The implications of this result will be discussed in Chapter Six.

One measurement artifact, however, was that only passing grades were included in the average. Perhaps the strike did not reduce grades so much as increase failures. To investigate this possibility Chapter Five looks at variables which affect the likelihood of failure.

Chapter Five

Statistical Analysis of Failures

Introduction

This chapter considers the relationship between failures and the strike. First gross percentages are presented and then a multivariate analysis follows. The order of presentation is essentially the same as that of the last chapter.

It is perhaps important to again point out the method of measuring failures lest some proportions appear too large. Anyone who fails any of the included subjects counts as failing in the category. The detailed explanation is found in Chapter Three.

Failure Rates of Strike and Non-strike Students

Tables 5.1 and 5.2 show the relation between subject area and failure and faculty and failure for students affected and not affected by the strike. Table 5.1 shows for each subject the percentage who failed one or more courses.

Table 5.1

Failure Rates By Subject Area and Strike

	All				1980	
	Non-strike		Strike		Non-strike	
	%	N	%	N	%	N
ACCTF	15.1	53		0	11.1	9

ANGLF	9.1	11		0	0	1
ANTRF	6.0	67	0	5	0	8
ASTRF	4.3	46	0	3	0	1
BIOLF	6.1	528	12.0	25	6.0	83
CANAF	7.4	94		0	0	5
CLASF	3.6	55	0	3	0	7
CHMIF	12.9	534	13.8	29	5.4	92
COMMF	11.7	744	19.6	56	13.6	132
COSCF	10.9	440	10. 6	47	7.6	79
DEUTF	2.8	109	0	5	5.0	20
ECONF	6.3	909	7.7	65	6.4	141
EDUCF	2.1	140		0	0	15
ENGLF	7.2	902	11.1	27	8.8	91
ENGRF	8.9	123	0	4	0	15
ESPAF	1.3	158	0	4	0	26
ESTDF	13.6	22		0	16.7	6
FINAF	0	2		0		0
FOLKF	0	9		0	0	1
FRANF	4.1	293	50.0	4	2.0	49
FRENF	2.1	330	0	12	0	45
GEOGF	4.3	276	0	9	4.8	21
GEOLF	8.8	136	0	7	12.5	8
GRECF	0	2		0	0	2
GSCIF	0	3	0	1	0	2
HISTF	5.1	336	6.7	15	2.9	34
INFOF	0	6		0	0	2
INTEF	0	7		0	0	5
ITALF	4.7	107	0	9	0	19

JURIF	11.0	164	0	21	15.8	38
LATNF	0	1		0		0
LINGF	0	30		0		0
MATHF	15.9	571	18.2	33	23.0	74
MUSCF	20.8	24	0	1	16.7	6
NATIF	2.4	40		0	0	12
NURSF	0.9	113	0	6	0	18
PHEDF	5.7	348	0	8	5.7	53
PHILF	6.0	299	14.3	14	10.5	38
PHYSF	15.5	431	11.8	17	13.0	54
POLIF	4.1	492	6.1	33	1.6	63
PSYCF	5.6	1372	11.0	73	3.5	230
RLSTF	2.5	119	0	8	0	17
RUSSF	5.9	17	0	2	0	1
SOCIF	4.2	1001	5.0	40	0	152
SPADF	3.4	148	0	3	0	26
SRELF	0	13		0		0
SUOMF	0	4		0		0
SWLFF	2.3	260	12.5	8	0	46
THEAF	0	3		0	0	3
TRANF	2.8	215	12.5	8	5.9	34
VISAF	0	4		0		0
WOMNF	9.1	11	0	2	50.0	2

On those Natural Science courses with a large number of students, a higher percentage of strike students failed Biology, Chemistry and Computer Science, while a lower

percentage failed Mathematics and Physics.

Table 5.2 shows the overall and faculty summaries.

Table 5.2

Failure Rates by Faculty

	All Non-strike		Strike		1980 Non-strike	
	%	N	%	N	%	N
ALLFAIL	18.2	2697	22.9	131	18.2	391
NATFAIL	17.4	1278	21.4	84	14.3	196
SOCFAIL	8.1	2139	10.3	116	5.7	318
ARTFAIL	6.5	1569	11.9	59	6.3	206
PROFAIL	7.7	1668	15.7	83	8.9	271

Here it appears that a higher percentage of strike students fails than of either all non-strike students or 1980 non-strike students.

As in the last chapter, however, these results may be deceptive. For we know from Chapter Three that Sudbury students fail more than non-Sudbury students do. And again we have not controlled for the influence of Grade 13 or Grade 12 grades on the distribution of failures. Consequently the next section attempts to look at the statistical relations between STRIKE and failures.

Multivariate Analysis

The regression analysis of failures differs from that for grades in that coefficients will be lower due to the dependent variable being a dichotomy. A discriminant

analysis would therefore have been appropriate had the independent variables been measured at interval level. However since some of the independent variables were also dichotomies, we continue with regression analysis.

Correlations Underlying Regressions

The overall and faculty failure rates are used in the ensuing regression analyses. Table 5.3 shows the first-order correlations between these failure rates and the dependent variables.

Table 5.3

Correlations Between Independent Variables and Failure Rates

	ALLFAIL	NATFAIL	SOCFAIL	ARTFAIL	PROFAIL
GR13	-.235 1462	-.171 767	-.154 1146	-.145 830	-.143 899
GR12	-.289 1493	-.323 697	-.207 1208	-.174 870	-.155 945
YEAR	-.001 2828	-.034 1362	-.062 2255	-.009 1628	.074 1751
LANG	0.036 2828	-.002 1362	-.025 2255	0.031 1628	0.033 1751
SEX	0.147 2828	0.129 1362	0.066 2255	0.084 1628	0.150 1751
YOB	-.048 2828	-.076 1362	-.081 2255	-.054 1628	0.041 1751
STRIKE	0.025 2828	0.025 1362	0.018 2255	0.040 1628	0.062 1751
SUDBURY	0.031 2828	0.012 1362	0.013 2255	0.008 1628	0.043 1751

The highest correlations with failing are Grade 13 and Grade 12 grades.

Comparing Multiple Correlations between Regression Equations

Table 5.4 compares R squared for a model including grade 13, YEAR and STRIKE with R squared for a model including only grade 13 and YEAR. The results show that STRIKE does not affect failures, because including STRIKE does not raise the multiple correlation.

Table 5.4

R-Squared Change from Adding Strike to a Two-Variable Model Predicting Failures

Failures	R Squared For 3 Variable Model	R Squared For 2 Variable Model	Difference
ALLFAIL	.057	.057	.000
NATFAIL	.031	.030	.001
SCCFAIL	.027	.027	.000
ARTFAIL	.024	.022	.002
PROFAIL	.031	.027	.004

The results of a comparison of the four-variable model including grade 13, YEAR, SUDBURY, and STRIKE, with the three-variable model excluding STRIKE are shown in Table 5.5.

Table 5.5

R-Squared Change from Adding Strike to a Three-Variable Model Predicting Failures

Failures	R Squared For 4 Variable Model	R Squared For 3 Variable Model	Difference
ALLFAIL	.058	.057	.001
NATFAIL	.031	.030	.001

SOCFAIL	.027	.027	.000
ARTFAIL	.024	.022	.002
PROFAIL	.032	.028	.004

As can be seen, the results are almost identical, and STRIKE makes little difference.

Comparing Betas in Regression Equations

Table 5.6 shows the Betas for the different equations, overall, and then for the different divisions. A positive beta indicates a positive relationship between experiencing the strike and failing courses.

Table 5.6

Betas for Predicting Failure

from Several Independent Variables

	ALLFAIL			
	6	4	3	2
GR13	-.219	-.240	-.239	-.237
YEAR	.018	.021	.017	
SUDBURY	.021	.031		
SEX	.099			
LANG	.015			
STRIKE	.024	.022	.035	.040

NATFAIL

	6	4	3	2
GR13	-.150	-.170	-.170	-.173
YEAR	-.030	-.027	-.027	
SUDBURY	-.005	.003		
SEX	.102			
LANG	-.021			
STRIKE	.046	.044	.045	.036

SOCFAIL

	6	4	3	2
GR13	-.143	-.150	-.150	-.156
YEAR	-.060	-.058	-.059	
SUDBURY	.001	.003		
SEX	.041			
LANG	-.037			
STRIKE	.046	.045	.046	.028

ARTFAIL

	6	4	3	2
GR13	-.135	-.147	-.147	-.148
YEAR	-.011	-.009	-.008	
SUDBURY	-.013	-.006		
SEX	.055			
LANG	.019			
STRIKE	.056	.055	.052	.049

PROFAIL

	6	4	3	2
GR13	-.119	-.157	-.156	-.148
YEAR	-.004	.083	-.079	
SUDBURY	.050	.037		
SEX	.207			
LANG	.008			
STRIKE	.020	.031	.046	.071

These results show that the strike had only a small correlation with failing one or more courses. It appears that the strike could not have led to any great increase in failures. In all cases the coefficients are too small to exclude random variations. Hence we may assume that these students were not generally more predisposed to failures.

Summary

Although there was no difference in grades between strike and non-strike students, there could have been a difference in the probability of failure. In this chapter, we looked for such a difference. There was a slightly higher percentage of failures among strike students. However more marginal students go to university from Sudbury. This prompted further analysis. Multivariate techniques showed that the strike had no essential role. In view of the size of the sample, it is reasonable to conclude that there was no important difference between Laurentian students who had been affected by the strike and those who had not been affected by

the strike in terms of the probability of failure.

The next chapter treats withdrawals. If strike students did not get lower marks, and they did not fail much more than non-strike students, perhaps they were more likely to withdraw from courses.

Chapter Six

Statistical Analysis of Withdrawals

Introduction

In the last two chapters, we looked at the effects of the strike on Marks and on Failures. However some students withdrew from courses prior to the date on which an F would be assigned and were given a W. This chapter then considers the effects of the strike on withdrawals.

Withdrawal Rates of Strike and Non-strike Students

Tables 6.1 and 6.2 show the relation between subject area and withdrawal and between faculty and withdrawal for students affected and not affected by the strike.

Table 6.1

Withdrawal Rates By Subject Area and Strike

	All				1980	
	Non-strike		Strike		Non-strike	
	%	N	%	N	%	N
ACCTW	8.6	58		0	0	1
ANGLW	0	11		0	0	1
ANTRW	5.6	71	0	5	0	8
ASTRW	6.1	49	25.0	4	0	1
BIOLW	4.7	552	3.8	26	3.5	86
CANAW	1.1	95	100.0	1	0	5
CHMIW	5.5	564	6.5	31	5.2	96
CLASW	8.3	60	0	3	12.5	8

COMMW	8.2	801	9.8	61	8.3	144
COSCW	7.1	468	4.1	49	9.2	87
DEUTW	6.0	116	0	5	0	20
ECONW	4.0	947	4.4	68	4.1	147
EDUCW	6.0	149		0	6.3	16
ENGLW	6.7	958	10.0	30	6.3	95
ENGRW	2.4	126	0	4	0	15
ESPAW	8.7	173	0	4	7.1	28
ESTDW	4.3	23		0	0	6
FINAW	33.3	3		0		0
FOLKW	0	9		0	0	1
FRANW	4.0	297	0	4	7.8	51
FRENW	4.4	341	7.7	13	4.3	47
GEOGW	6.8	295	10.0	10	4.5	22
GEOLW	8.7	149	0	7	11.1	9
GRECW	0	2		0		0
GSCIW	0	3	0	1	0	2
HISTW	5.1	354	0	15	0	34
INFOW	0	6		0	0	5
INTEW	0	7		0		0
ITALW	3.6	111	0	9	0	19
JURIW	6.3	175	4.5	22	0	38
LATNW	0	1		0		0
LINGW	3.2	31		0	12.5	8
MATHW	6.0	598	2.9	34	14.3	84
MUSCW	0	24	66.7	3	0	6
NATIW	2.4	42		0	0	12

NURSW	5.0	119	0	6	0	18
PHEDW	3.4	351	0	8	3.7	54
PHILW	5.7	317	6.7	15	0	38
PHYSW	9.0	469	5.6	18	10.0	60
POLIW	3.5	510	2.9	34	4.5	66
PSYCW	3.2	1417	2.7	75	1.7	234
RLSTW	4.1	123	11.1	9	11.1	18
RUSSW	5.6	18	0	2	0	1
SOCIW	3.1	1033	2.4	41	1.5	154
SPADW	0	148	0	3	0	26
SRELW	7.1	14		0	100.0	1
SUOMW	0	4		0		0
SWLFW	3.0	268	0	8	2.1	47
THEAW	25.0	4		0	25.0	4
TRANW	3.2	217	0	8	5.7	35
VISAW	0	4		0		0
WOMNW	8.3	12	0	2	0	2

Table 6.2 looks at overall withdrawals and those in different faculties.

Table 6.2

Withdrawal Rates by Faculty

	All				1980	
	Non-strike		Strike		Non-strike	
	%	N	%	N	%	N
ALLWITH	12.4	2766	15.7	134	12.9	536
NATWITH	9.4	1334	7.1	85	11.5	208
SOCWITH	5.3	2213	5.0	119	4.0	327
ARTWITH	7.0	1636	7.9	63	6.1	213

PROWITH	6.5	1741	6.9	87	7.0	285

In general, a higher percentage of strike students withdrew from one or more of all courses, but a lower percentage withdrew from one or more Natural Science course.

Correlations Underlying Regressions

The overall and faculty withdrawal rates are used in the ensuing regression analyses. Table 6.3 shows the first-order correlations between these withdrawal rates and the dependent variables.

Table 6.3

Correlations Between Independent Variables and Withdrawal Rates

	ALLWITH	NATWITH	SOCWITH	ARTWITH	PROWITH
GR13	-.082 1499	-.077 797	-.057 1187	-.021 862	-.050 936
GR12	-.122 1529	-.061 732	-.105 1252	-.099 907	-.091 985
YEAR	-.002 2900	-.006 1419	-.023 2332	-.003 1699	.007 1828
LANG	0.022 2900	-.039 1419	0.017 2332	0.033 1699	0.006 1828
SEX	0.024 2900	0.025 1419	0.003 2332	0.016 1699	0.057 1828
YOB	-.026 2900	-.009 1419	-.056 2332	-.013 1699	-.011 1828
STRIKE	0.020 2900	-.019 1419	-.003 2332	0.007 1699	0.004 1828
SUDBURY	0.021 2900	-.008 1419	0.019 2332	-.012 1699	0.036 1828

Chapter 6
Statistical Analysis of Withdrawals

For Natural Science and Social Science withdrawals, the correlation with strike is negative indicating that strike students were less likely to withdraw. But in general the correlations are small.

Comparing Multiple Correlations in Regression Equations

Table 6.4 compares R squared for a model including grade 13, year and strike with R squared for a model including only grade 13 and year.

Table 6.4

Change in R Squared from Adding Strike
to a Two Variable Model Predicting Withdrawals

Withdrawals	R Squared For 3 Variable Model	R Squared For 2 Variable Model	Difference
ALLWITH	.007	.007	.000
NATWITH	.006	.006	.000
SOCWITH	.003	.003	.001
ARTWITH	.001	.000	.001
PROWITH	.003	.002	.001

The results show that strike does not affect withdrawals.

Summary

There were some differences in the gross percentages between strike and non-strike students with overall withdrawals slightly higher for strike students and Natural Science withdrawals slightly lower. These differences were

quite small. In addition, a multivariate analysis did not show any effect of strike on withdrawals. Consequently we conclude that students affected by the strike were not therefore more likely to withdraw from subsequent courses in university.

Chapter Seven

Some Problems of Interpretation

Introduction

In the previous chapters we showed that there were no significant differences between strike students and non-strike students in either grades they achieved or the probabilities of failure or withdrawal. To know whether this indicates a direct effect of the strike on individual students, it is necessary to ascertain whether similarly qualified students came to Laurentian from the Sudbury Board in the strike year as in previous years. If the contingent of students attending Laurentian in the strike year had higher average ability than contingents had in previous years, this ability differential might compensate enough to hide some deleterious effects of the strike. This "selection effect" might constitute an alternative account of the data presented earlier. This chapter sketches such an alternative, and then presents evidence showing that it is probably a false account. The importance of the argument is that, if the students in our sample are typical of entering students from the Sudbury Board, their performance will constitute a measure of the effect of missing school.

An Alternative Account

Some of the effects the strike had on students did not take long to materialize. Radecki and Evans state that 840 students dropped out, of which 246 were dropouts from grade

13, while the normally expected dropout loss would have been 500 for the whole group. If the increase was proportional across the group that would mean 100 more students dropped out then was to be expected.

This phenomenon has been observed elsewhere. However it is likely that the students dropping out were not those intending to continue to university. Consequently, while there is an effect, that effect may not be manifested further on in the educational system.

Apart from students who quit prior to completing Grade 13, the strike may have decreased the proportion of students who would have gone to university. The total pool of students going to university may have shrunk.

The latter possibility is not excluded by the fact that Laurentian enrolments did not shrink. For it is possible that strike students picked different universities.

No control has been made for what will be called the selection effect. Students select whether or not they will continue to university and if they do continue, choose the university they want to go to. The relevant factors have been the subject of much detailed research, but it is probable that students who do badly in high school, students of poor parentage, and students from rural areas will choose not to continue.

However Laurentian's status as a small Northerly less-well-known university means that students with the highest marks and those whose parents are wealthier are more likely to attend another university. Thus Laurentian, in

effect tends to attract students in the middle.

A simple way to present this is to imagine all the students from Sudbury high schools spread out in a line. A variably sized window is moved around over the central and upper parts of the line. Those visible through the window are Laurentian students.

This would, in itself, not affect the arguments on the relevance of the data presented here if the window of selection remained constant. However, it is probable that academic interruptions do affect the window both in altering the number of students who go to university as well as tha number who leave the area to attend university.

Selection Characteristics

One way of looking at the window is to see whether there was a change in the average grades of those who entered Laurentian. To look at this we calculated a line or equation to predict the grade which entering students should have using only those students in the sample and not affected by the strike. This gave a predicted grade 13 mark of 78.8607 + .68842 x year.

We then ask for the strike sample, was their actual average mark higher than that predicted? This would indicate that the window had moved.

Strike students had slightly higher averages in grade 13 than would have been predicted on the basis of a regression on year. The average of the strike students was 83.7 while their predicted average on the basis of year was 82.3.

Chapter 7
Some Problems of Interpretation

Grade 12 marks did not show an upward movement over the term so only average grades are compared. The mean for the strike students was 73.1 while that for all students was 73.9.

These results are somewhat conflicting in terms of the window theory. While the grade 13 marks show some possible movement bringing better students to Laurentian the grade 12 marks indicate that slightly poorer students came. It is likely that grade 12 marks are more accurate considering the strike as a possible factor making teachers more lenient in their grading.

For that reason, it would appear that the first year students coming from Sudbury were not better qualified as a result of some window phenomenon, and therefore there is some justification in treating students' relative university performance as a result of the strike.

University Choice by Area of Origin

Another way to look at the characteristics of students picking Laurentian uses Admission Data System Reports for the Ontario Universities' Application Centre which presents one table of choice broken down by geographic area. Their geographic grouping number twelve includes Manitoulin, Sudbury District, Algoma, Cochrane, Timiskaming, and Sudbury Regional Municipality. Although this includes a larger area than Sudbury, changes in Sudbury student totals should affect changes in the number of students from this larger area choosing Laurentian. To check this, Tables 7.1 and 7.2 have

been calculated from Tables 7.0, 7.1, and 8 supplied by the Application Centre. Data are based on registered applicants.

Table 7.1

Percent Registered of all Area 12 Students

	Making Three Choices Including Laurentian University	Total All Universities	Making First Choice Laurentian University	Total All Universities
77	29.7	1318	28.6	929
78	28.3	1259	23.7	908
79	27.3	1246	26.1	913
80	27.9	1226	26.7	879
81	28.6	1222	26.9	839

Table 7.2

Percent of Registered Students From Area 12 Choosing Arts or Science

	Arts at Laurentian University	Total Arts	Science at Laurentian University	Total Science
77	45.3	611	16.1	311
78	42.7	468	19.9	282
79	33.5	477	17.0	247
80	37.2	471	16.3	258
81	39.2	475	23.5	243

Table 7.1 shows that 1980 was not a particularly low or

high year for students registering in university from the area. Also the proportion going to Laurentian was not much different. Consequently it seems that the students in our sample can be considered typical university students from the Sudbury area.

The Consequent Irrelevance of Socioeconomic Status

That students were typical in the period is an important aspect of the analysis. Laurentian University unfortunately does not keep data on the occupations of students' parents. But if the entering group did not change in size or grade, that means that the socioeconomic composition remained largely the same. Also, the fact that we found no difference due to the strike means that lower-status students could not have been affected more by the strike. If nobody is affected, then S.E.S. can hardly be a relevant factor in who gets affected.

That S.E.S. is irrelevant is important. One of the main defects of the study as it was originally envisaged was the lack of an S.E.S. measurement. Had there been a difference between strike and non-strike students, it could have been attributed to a constant effect on all students or to a differential effect having more influence on lower S.E.S. students. Interpretation of the results could similarly have been affected had there been a shift in enrolment from the Sudbury area. However the fortuitous combination of results enables the conclusion that the study would not have been improved by including an S.E.S. measure.

Chapter 7
Some Problems of Interpretation

The Effects of Substitute Education

In a situation where students miss school, it is possible that their parents provide a substitute such as a program of home study or school elsewhere. It is improbable that this had a great effect in the current study. Radecki and Evans state that "2.4% of the students made up the lost time by studying more." (1982:165). However 550 did attend schools elsewhere. But for most students no replacement was provided. The extra summer school program hoped for by the Board did not materialize. And it must be assumed that there was no real substitution of school-related activities.

Assuming the Validity of University Grades

An important assumption which is not considered later is the validity of university grades. Challenging the use of these as criteria could lead to alternative interpretations of the results herein presented. However this would be an exteme course. Future university grades tend to measure the same things as first-year grades. Discounting first year grades would likely discount the whole of university education.

Summary

An initially plausible alternative account of the lack of difference in student grades is based on attributing this to a change in entering students' characteristics. While

grade 13 marks of strike students were slightly higher, perhaps indicating such a change, this may have been due to teachers compensating for the strike. However two items of data do suggest that entering students were similar in the year following the strike. First, grade 12 marks did not increase as would have been expected under the alternative account. Second, OCUA data do not show a shift in the percentages of students attending Laurentian from the area relative to those going to Southern universities. This means that the influence of the strike can plausibly be considered to operate through the associated lack of schooling rather then through some more complicated demographic shift as has been envisaged here. One conclusion which can be drawn from this is that S.E.S. did not play an important role in mediating the effects of the strike.

Chapter Eight

Conclusion

Recapitulating the Findings

The study was an attempt to find the objective effects of a three-month high-school strike on students attending university. For this purpose, students affected by the strike were compared with students who were not so affected. The comparisons took place with respect to average marks, percentage of students failing a course or courses, and percentage of students withdrawing from a course or courses.

Average marks of those affected by the strike did not differ from the marks of those not affected. In addition, multivariate analyses showed that the strike had no important effect on grades.

Although a slightly higher percentage of students affected by the strike failed than of non-strike students, this modest difference could have arisen from the higher proclivity of Sudbury students towards failure. Multivariate analysis showed that the strike was not an important determinant of the probability of failure.

Small differences also appeared between the percentages of students of strike and non-strike groups who withdrew from courses. Multivariate analysis did not attribute an important role to strike in the determination of withdrawals.

The finding was that no important differences existed between strike students and others in any of the three areas where such differences might have been expected. For any

student, neither marks, failures, nor withdrawals could have been much better predicted by knowing if the student had been affected by the strike.

The Effect of Grade Thirteen

The simplest explanation of these results is that three months of grade thirteen education did not affect university performance. Alternatively expressed, non-strike students who had an additional three months of grade-thirteen education did not gain by it.

Certainly other interpretations of the data have not been entirely ruled out. The model presented here may be subject to specification error as a result of unmeasured variables. One such possibility was argued against in Chapter Seven. Nevertheless in the absence of information to the contrary, the best guess as to the effect of three months of grade thirteen on university performance is that there is none.

Explaining the Lack of Effect

Why was there no effect? A number of questions arise at this stage. It may be that three months missed in any other grade would be important but grade thirteen does not matter so much. Or perhaps three months at any point in the school career would not matter. A plausible research project to consider this issue would involve investigating students in early secondary schools and elementary schools affected by a future strike.

Chapter Eight
Conclusion

It may have been important that the period chosen for the study was one where the freedom of the student to choose his own courses and program in Ontario high schools was at its zenith. The lack of effect could then be attributed to the relative lack of structure and ordered content in the high school curriculum. This could be investigated by a repeat of the current study after the government brings back a more highly structured program into secondary education. One difficulty with a project of this sort is that it would depend on a change in public policy.

Concluding Results

Two generalizations do emerge from the research presented here. First, that three months of grade thirteen do not contribute significantly to university-relevant skills. Second, that high-school-teacher strikes for periods of three months may not have significantly deleterious consequences for students who will continue to university. These conclusions must be qualified by the specific characteristics of time, place, and sample, as well as considered in the light of the alternative interpretations discussed in the text. Nevertheless they are important results which could not have been definitely predicted prior to the present study.

References

Brison, David W. and Anthony H. Smith

1978 The Effect of Ontario Teachers' Strikes on Students. Toronto: The Ministry of Education , Ontario.

Caldwell, William E. and Michael D. Moskalski

1981 "The Effect of School District Strikes on Student Achievement." Government Union Review 2(4):3-14.

Clement, Wallace

1981 Hardrock Mining: Industrial Relations and Technological Changes at INCO. Toronto: McClelland and Stewart.

Deverell, John and the Latin American Working Group

1975 Falconbridge: Protrait of a Canadian Mining Multinational. Toronto: James Lorimer.

Duncan, O. D.

1975 Introduction to Structural Equation Models. New York: Academic Press.

Fullan, Michael and Glenn Eastabrook

1979 The Effects of Ontario Teachers' Strikes on the Attitudes and Perceptions of Grades 12 and 13 Students: Three Studies of the Effects of Teachers' Strikes II. Toronto: The Ministry of Education, Ontario.

Heyns, Barbara

1979 Summer Learning and the Effects of Schooling. New York: Academic Press.

Higgins E.G. and F.A. Peake

1973 Sudbury Then and Now: A Pictorial History of Sudbury and Area: 1883-1973. Sudbury: The Sudbury Chamber of Commerce.

Holmes, Mark and Doris Jantzi

1979 The Effects of Ontario Teachers' Strikes on Students-Student Achievement: Three Studies of the Effects of Teacher's Strikes I. Toronto: The Ministry of Education, Ontario.

Hyman, Herbert H.

1975 The Enduring Effects of Education. Chicago: University of Chicago Press.

Lucas, Rex A.

1971 Minetown, Milltown, Railtown: Life in Canadian Communities of Single Industry. Toronto: University of Toronto.

Lytle, James H. and J.M. Yanoff

1973 "The Effects (if any) of a Teacher Strike on Student Achievement." Phi Delta Kappan 55(4):270

Mosteller, Frederick, and John W. Tukey

1977 Data Analysis and Regression: A Second Course in Statistics. Reading, Massachusetts: Addison-Wesley.

Ontario Universities' Application Centre Undergraduate Application Service

1978 Admission Data System Report 1977. Guelph: Council of Ontario Universities.

1979 Admission Data System Report 1978. Guelph: Council of Ontario Universities.

1980 Admission Data System Report 1979. Guelph: Council of Ontario Universities.

1981 Admission Data System Report 1980. Guelph: Council of Ontario Universities.

1982 Admission Data System Report 1981. Guelph: Council of Ontario Universities.

Pedhazur, Elazar J.

1982 Multiple Regression in Behavioral Research: Explanation and Prediction. New York: Holt, Rinehart and Winston.

Piaget, Jean

1970 The Science of Education and the Psychology of the

Child. New York: Orion.

Radecki, Henry

1979 The 1978-79 Strike at INCO: The Affects on Families. Sudbury: SIS Analysis.

Radecki, Henry

1981 One Year Later: The 1978-79 Strike at INCO. Sudbury: SIS Analysis.

Radecki, Henry and Susan Evans

1982 Teachers' Strike Study: Sudbury, Ontario 1980. Sudbury: Laurentian University.

Swift, Jamie and the Development Education Centre

1977 The Big Nickel: Inco at Home and Abroad. Kitchener, Ontario: Between the Lines.

Thompson, John F. and Norman Beasley

1960 For the Years to Come: A Story of International Nickel of Canada. New York: Putman's.

Watson, Cicely and Mohindra Gill

1979 The Effects of Ontario Teachers' Strikes on Students: Effects on Student Flow, Dropout and Transitions: Three Studies of the Effects of Teachers' Strikes III. Toronto: The Ministry of Education, Ontario.

Zigarmi, Drea and Ron Sinclair

1980 "The Effect of a Strike on Organizational Climate and Leadership: A Study of a Middle School in National Middle School Association's Research Committee and Publications Committee." Selected Studies 1977-1979:65-75.

POOR

QUALITY

ORIGINAL